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120-CHANNEL, CHRONICALLY IMPLANTABLE, WIRELESS, POLYMER NEURAL INTERFACE

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There is an ever growing need for reliable, biocompatible interfaces for chronic recording/stimulation of neural tissue. This capability is required for identifying and understanding the underlying mechanisms of the nervous system and developing neuroprosthetics to treat neurological disorders. Most of the research used to investigate these conditions requires animals to be in their natural environment. We present a fully-implantable, wireless interface for neural recording and stimulation consisting of a polymer microelectrode array integrated with a hermetically-sealed microelectronics package. This neural interface is adaptable for the study of a variety of neurological disorders.

Several different wireless neural interfaces have been developed in recent years. There are four major distinguishing elements of this neural interface: 1) polymer, not silicon, microelectrode array, 2) fully-implantable, as opposed to percutaneous, microelectronics package, 3) hermetically-sealed, not polymer-coated, microelectronics package, and 4) 120 channels, all capable of stimulating and recording. While each of these elements has been previously published, this is the first demonstration of the combination of these elements.

There are two main components to this wireless neural interface: 1) polymer microelectrode array and 2) hermetically-sealed electronics package. The polymer microelectrode array consists of multiple layers of metal sandwiched between polyimide layers. The individual electrodes are comprised of electrochemically-activated iridium oxide with an impedance of 9.5 k Ω at 1 kHz. The electrodes are capable of withstanding over 50 million pulses, with 500 mC of total charge delivered.

The microelectronics package consists of a biocompatible metal can on a ceramic substrate. Assembly involves brazing a ceramic substrate to a metal ring, three-dimensional integration of microelectronics, and laser welding of a lid to create a hermetic seal. The microelectrode array and inductive coils (for power and data transfer) are integrated with the package using gold rivet bonds and high-density electrical vias fabricated through the ceramic substrate.

The polymer microelectrode array and the components of the implanted electronics package have undergone extensive biocompatibility testing and have passed the FDA mandated ISO 10993 biocompatibility testing for fully implanted devices. The fully assembled devices are currently undergoing further lifetime testing and *in vivo* studies.

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